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Logging Residues Disposal Hazards in Georgia's Piedmont

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FIGURE 1.—*Logging debris left after a mixed loblolly pine hardwood stand (commercial pine, basal area 45) was clearcut on the Georgia Piedmont.*

FIGURE 2.—*The slash was disposed of and the site prepared for reforestation by prescribed burning in May, 6 months after clearcutting. This area is typical of many on the Piedmont, as evidenced by the old roadbed in the foreground.*

The Problem

Over 100,000 acres of Southern pine are clear-cut annually on the Georgia Piedmont. Logging residues left on these harvested areas present forest-land managers with several problems. Slash impedes the movement of both men and machines engaged in regeneration, thereby reducing their efficiency and increasing costs. Its shade reduces survival and retards early growth of the sun-loving pine seedlings. It also provides a nurse site for the establishment of unwanted vegetation that competes all too favorably with the pine. Moreover, slash increases the fire hazard which results in larger fires because it produces higher fire intensities and makes the job of line construction more difficult.

Logging debris from intermediate cuts is a concern because of the potential damage to the over-story from chance wildfires. In plantations, some form of row thinning is generally used which produces heavy slash concentrations along the harvested rows. The height of these concentrations often enables the slash to act as a ladder fuel to transport fire into the live tree crowns.

Objective consideration of proposed solutions to these problems depends on a knowledge of slash deterioration times and accompanying changes in the fire hazard.

Hazard Duration

Foliage Changes:

The warm, humid conditions necessary for rapid slash deterioration prevail throughout most of the year on the Georgia Piedmont. Slash decay begins immediately after cutting, as the foliage and twigs lose moisture. The fiber saturation point (30 per cent) may be reached in less than two weeks during the summer, but more than three months may be required in the winter (Table 1). During the summer months at least, precipitation appears to have little effect on slash drying rates until the moisture content drops below the fibre saturation point. Thereafter, the slash responds to changes in the weather as other dead fuels do.

The moisture loss is paralleled by changes in foilage color from dark green to yellow green. Slash flammability steadily increases during this period and reaches a peak shortly after the needles turn from yellow to a deep copper color, just prior to the initiation of needle fall. Wind, rain, snow, and ice all have an important role in needle drop, which begins within six months after logging and is generally completed during the

TABLE 1.—Average Deterioration Schedule for Loblolly Pine Slash on Georgia's Piedmont

Season of Cutting	SLASH CONDITION					
	Foliage yellow	Defoliation		Branch Failure		Complete Decomposition of Branchwood
		Start	90% Complete	Start	90% Complete	
	-months-	-months	-months-	-months-	-months-	-months
Spring Mar.–May	3/4–1½	3–5	18–22	30–36	44–50	60–66
Summer June–Aug.	1/2–3/4	2–3	16–20	27–33	44–50	60–66
Fall Sep.–Oct.	3/4–1½	3–5	20–24	30–36	44–50	60–66
Winter Nov.–Feb.	2 –3	4–8	20–26	33–39	44–50	60–66

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FIGURE 3.—*A 20-year-old plantation after thinning to one-half its original basal area. Approximately eight tons of ground fuel per acre are present.*

second year on exposed sites (Table 1); however, when an over-story is present and the slash is protected from the elements, as after thinning, defoliation times are extended.

Fire hazard is dramatically altered as needle fall progresses. While still attached to the branchlets, the needles are arranged to enhance burning and are exposed to the wind so that they dry rapidly after wetting and remain more flammable than the litter layer beneath. Once on the ground, they tend to mat, producing a more compact fuel bed that retards air movement and thus combustion, and also allows the needles to retain moisture for long periods of time.

Wood Decay:

The first visible signs of wood decay appear a month or two after cutting, when sap-stain fungi produce changes in the color of the sapwood. The initial extent of the activity of sap-stain fungi, as well as of wood-decay fungi, depends upon colonization of the fresh slash by bark beetles and sawyer beetles. Neither of these fungi can penetrate pine bark; thus, entry points are restricted to the severed branch ends and those branches damaged during logging. However, the myraid entrance and exit holes of bark and sawyer beetles provide almost unlimited access to the fungi.

Branches supporting the severed tops begin to give way during the third year, and by the end of the fourth year most of the elevated material is on the ground (Table 1). As the slash loses its vertical component, line building becomes easier and ease of access and visibility are increased. The debris no longer actively contributes to fire intensity, although localized hot spots can still develop. After five or six years, the slash has virtually disappeared on most sites and any that still remains is certainly not a fire hazard.

Instances where the slash does not follow this time schedule are often attributable to the premature loss of bark.

FIGURE 4.—*The same plantation after prescribed burning. Elimination of the fine fuels has reduced the fire hazard considerably.*

The bark serves as a protective covering that insulates the wood from solar radiation and conserves moisture. When it is damaged during the logging operation, the exposed wood dries out and becomes case-hardened, often before fungi become established. Decay is thus retarded, and the slash remains a hazard for a longer period of time. Moreover, since more undecayed wood is present and it tends to remain at low moisture contents, less available heat is required to ignite the wood. Higher fire intensities are thus created.

Chemical Changes:

Chemical as well as physical changes take place in slash fuels as they decay. Caloric values (a measure of the total amount of heat released from a fuel during combustion) determined for loblolly pine slash showed that needles consistently held more energy, and wood less energy, than bark. Small changes in the values occur as the slash deteriorates, but they are probably of little significance. The most important factor from a fire standpoint is the decrease in the rate at which this energy would be released by a fire with the passage of time as the needles and branches fall to the ground.

Slash Treatments

Prescribed Fire:

If site preparation as well as slash disposal is needed to assure adequate regeneration, one treatment that will accomplish both objectives rather than two separate ones is usually more economical. Prescribed fire is such a treatment and, as such, is often recommended, especially in the hilly terrain of the Georgia Piedmont where the threats of soil compaction and soil movement are important considerations. The use of fire is by far the most economical treatment, costing only a fraction of mechanical methods. Further, it has few deleterious side-effects when used properly.

However, to write an effective fire prescription, and then safely carry it out, requires experienced personnel and a specific set of weather conditions that may not commonly occur during certain times of the year. The possibility of the fire escaping must also be considered.

Although prescribed fire can be used at any stage of the slash decomposition process, slash disposal objectives are maximized if fire is used soon after the needles turn copper, but before they begin to fall (fig. 1 & 2).

Prescribed fire is also an economical treatment for reducing the fire hazard after thinning closely spaced pine stands. A burn prescribed just as the slash foliage is turning yellow will consume the needles and small branches without igniting the heavier slash fuels. The stand can still be fire-proofed at a later date after the needles have turned copper, but a more intense fire is then generated so that more exacting weather conditions and more skillful application are required to prevent damage to the overstory (fig. 3 & 4).

Mechanical Methods:

Proponents of mechanical methods justify the increased costs of these methods through elimination of the uncertainties of prescribed fire and additional benefits such as reduced sprout competition. The weather is not such a restriction either, which permits more effective advance scheduling of men and equipment. Also, slash disposal can begin immediately after logging without waiting for the debris to cure.

However, deeply eroded portions of the Piedmont severely limit the efficiency of mechanized treatments. Trans-

portation of heavy equipment into areas to be treated can pose difficulties; and, of course, break-downs are exasperating as well as expensive. Drum-type choppers, which are the most commonly used mechanical methods on the Georgia Piedmont, have the added disadvantage of pushing the branchwood into the ground, where it appreciably reduces the rate of fireline construction during chance wildfires. This obviously results in a larger burn.

The practice of windrowing is one mechanical treatment in particular that can rarely be recommended on the Piedmont. Much of the topsoil has already washed off the uplands onto the lower slopes and bottoms because of past agricultural practices. Possible further degradation of these sites through soil disturbance from heavy machinery should be avoided. Windrows also create a physical barrier to planting and fire control equipment, remain aesthetically unpleasing for a number of years, and take up space that might be better utilized.

Windrow burning presents several disadvantages from an air quality standpoint. Prescribed burners have to be cognizant of potential smoke-related hazards and discomforts created down-wind. Windrow burn-out times often necessitate night-time burning which is stringently requlated by burning guidelines and/or state laws. Once a windrow is extinguished, it is virtually impossible to reignite without further work; the fine fuels have been consumed in the previous fire and the heavier materials thoroughly wet down in extinguishing the fire. Secondly, the soil mixed in with the fuel results in less efficient combustion, possibly creating more pollutants.

Summary

Slash deterioration rates differ somewhat from site to site and from year to year, but a good rule of thumb is to consider untreated logging debris a definite fire hazard for three years after logging on the Georgia Piedmont. Slash flammability increases after cutting, reaching a peak when the needles turn copper just prior to needle fall initiation. The slash hazard then decreases until decomposition eliminates the problem four or five years later.

Mechanical methods are capable of doing a more complete slash disposal and site preparation job after clear-cutting than prescribed fire, but at a much greater cost per acre. They may, however, also create more deleterious side-effects.

Judicious use of prescribed fire appears to be the most practical way of reducing slash accumulations in Georgia's Piedmont. In thinned stands, the burns are best accomplished as the slash foliage turns yellow; on clear-cuts, where site preparation objectives are as important as hazard reduction, the burns are best made when the foliage turns copper just prior to needle fall.